

Summary of Action Items from Previous Reviews

(Highlighted actions need to be also discussed at the Interconnect EDR)

LQX Cryostat Engineering Design Review (March 2001)

1. Interconnect pipe supports

Action: Fermilab needs to complete the design for pipe support in the interconnect regions.

2. Stability of tie rods under vacuum loads

Action: Fermilab should complete their analysis of mechanical stability of the tie rods under vacuum loads.

3. Use of automatic welding equipment

Action: Fermilab is evaluating eliminating the beam pipe – cold mass differential expansion bellows which would increase the radial clearance in that area.

Action: Fermilab needs to identify all welds that will fall below the requested clearances of 45 mm radial and 130 mm axial.

Action: CERN and Fermilab need jointly to address viable solutions to any space-restricted welds.

4. Interface between cryostat feet and jacks

Action: Fermilab needs to provide the details of the interface between the cryostat feet and jacks.

5. Interconnect region magnet splices

Action: Fermilab needs to determine the length of the corrector bus splice in the interconnect region.

Action: Fermilab needs to ensure adequate flow area for quench venting at the interconnects.

6. Shipping loads

Action: Fermilab needs to include shipping restraints that are capable of isolating the cryoassembly from anticipated shipping loads. The resulting loads on the cold mass support need to be kept below 2 g.

7. BPM feedthrough flanges

Action: Fermilab needs to add BPM cable feedthrough flanges to the design of the interconnects.

8. Cold bore temperature in the magnets

Action: CERN needs to determine if an actively cooled beam screen is required in Q1.

Action: If an actively cooled beam screen is required, Fermilab needs to add piping to supply an actively cooled beam screen in Q1, and LBNL needs to determine if this affects the DFBX design.

9. Cold bore temperature in the interconnects

Action: Fermilab needs to investigate how to maintain the cold bore at its specified temperature.

10. Drawings

Action: Fermilab needs to submit drawings that are critical to support design integration with CERN.

11. Transportation, lifting and handling

Action: Fermilab needs to prepare the tunnel interface specification. The specification should include transportation and handling criteria and limitations applicable on the surface, down the access shaft, to the transport vehicle, and to the installation location.

Action: Fermilab is requested to perform a simple dynamic response study of the quadrupole cryoassembly.

Action: Fermilab will transport Q2P1 around their site and take measurements to obtain some data on the mechanical stability of the cold mass.

Action: CERN needs to arrange for necessary lifting and handling tools to be used at the LHC.

Action: CERN needs to develop the full installation scenario for the quadrupoles, from receipt at CERN to final installation in the LHC.

12. IP end of Q1

Action: Fermilab is requested to propose a “shortest possible” IP end of the Q1 cryoassembly on the assumption that the BPM is located outside of the vacuum vessel.

Action: CERN needs to provide designs for the warm-to-cold transition, including stay-clear areas to Fermilab.

13. Stability of thermal shields

Action: Fermilab is requested to analyze the resistance of the thermal shield to buckling due to pressure in the extrusion piping and collapse due to eddy currents during quench.

14. Cold mass support

Action: Fermilab is requested to review the test data to determine the onset of failure.

15. Alignment tolerances and aperture reductions

Action: Fermilab is requested to establish a positional tolerance for the beam tube and confirm that the stack-up of tolerances is within the capability and reliability of the bellows.

Action: Fermilab is requested to evaluate the effect of the sag of the cold mass and cantilevered beam tube, and to work with the CERN Apertures Working Group to determine the effect on the aperture.

Action: CERN needs to confirm the allowable offsets for beam vacuum bellows.

Action: Fermilab needs to verify the weld interface between the cold bore and cold mass does not result in an aperture reduction.

16. Radiation effects

Action: Fermilab and CERN need to determine if radiation degradation testing needs to be performed on the sliding material.

Action: Fermilab is requested to estimate the contact doses for the inner triplet, particularly in the interconnects.

17. Electron cloud effects

Action: Subsequent to the review, Fermilab verified that electron cloud effects are included in the heat load table.

18. Vacuum pumping and pressure relief ports

Action: Fermilab needs to include an ISO-K-100 pumping flange in its design for the vacuum pumping port.

19. Cleanliness of the cold bore

Action: Fermilab plans to keep the cold bore closed after cleaning.

20. Trapped volumes

Action: Fermilab intends to confirm that no trapped volumes are present in the design.

21. Alignment of correctors

Action: Fermilab is requested to evaluate the design of the corrector mounting against the alignment requirements. Fermilab intends to submit a corrector interface specification and the method for alignment should be documented in detail in the specification.

22. Load simulation heaters

Action: Fermilab needs to determine the size and configuration of the load simulation heaters with CERN.

23. Helium inventory

Action: Fermilab is requested to specify the volume distribution of helium throughout the triplet.

24. BPM location and interfaces

Action: CERN needs to develop details of the BPM to enable Fermilab to complete the detailed design of the interconnect region.

Action: CERN needs to complete the Engineering Change Request process to formalize the change of BPM location.

25. Cryostat bellows sleeves

Action: Fermilab needs to complete the design of the bellows sleeves and instrumentation routing.

26. Heat exchanger pipes

Action: Fermilab is asked to provide CERN with details of the redesign of the heat exchanger connecting pipes.

MQXB Cold Mass Production Readiness Review (June 2001)

1. Acceptance Plan

- Action: Fermilab needs to include in the Acceptance Plan the process for dealing with exceptions or deviations from the expected results of the tests and checks, taking into consideration the results obtained on all the produced magnets. The process should identify who, or what group, has the authority to accept deviations.
- Action: Fermilab needs to iterate the draft as necessary to obtain a version approved by the US LHC Project Management Office and by CERN. The approved acceptance plan needs to be released in the CERN EDMS.
- Action: Include in the Acceptance Plan the possibility to eliminate the second thermal cycle tests in later magnets, and the procedure as to how to approve this change.
- Action: Eliminate peak voltage and temperature during quench as acceptance criteria.
- Action: Consider whether a tolerance of ± 15 units on the η Gdl is too tight.

2. Data format for magnetic field data

- Action: Fermilab and KEK need to finalize the details of the data exchange format that they will use to transmit magnet field data to CERN. They need to reach agreement with CERN on the format by September 2001.
- Action: CERN needs to identify to the US labs who will be responsible for the magnetic field data.

3. Process control during production

- Action: Fermilab needs to clearly indicate, in the QA plan, in the travelers, or in both, the authorizations and documentation that are required when deviating from the written instructions in the travelers.
- Action: Fermilab needs to have a system for training and certifying new technicians in operating procedures and in use of the travelers.

4. Mechanical straightness and twist

- Action: Fermilab should clarify the definition of the straightness tolerance when the MQXB Functional Specification is next revised.

5. Ringing (impulse) test

- Action: Fermilab is asked to consider impulse testing each individual coil.

6. Hi-pot tests

- Action: Fermilab is asked to reconsider the timing of hi-pot test during fabrication.
- Action: Fermilab is asked to reevaluate the level of voltage used for hi-pot tests between quadrants.

7. Coil aperture

Action: Fermilab is asked to consider reinstating the coil aperture check in the fabrication process.

8. Sign of b_{10}

Action: Fermilab needs to resolve their understanding of the new measurement system.

9. CERN deliveries of parts

Action: Fermilab and CERN need to be clarify delivery dates and quantities of the remaining parts to be supplied by CERN, and CERN needs to ensure timely delivery of parts and components to meet Fermilab's schedule requirements.

Action: Fermilab needs to continue to closely monitor the delivery schedules for CERN supplied parts and corrector subassemblies as well as the few remaining parts that Fermilab will procure directly.

10. Delta ferrite testing

Action: Fermilab is requested to transmit their delta ferrite acceptance criteria to KEK.

11. Current for taking harmonics data

Action: Fermilab needs to include steady state harmonic field data at all agreed field levels among its acceptance testing and criteria.

12. Ramp rate

Action: Fermilab (and KEK) should be aware of the expected de-excitation ramp rate of -30 A/s and, if necessary, perform tests on their prototype magnets.